

Identifying and separating impacts of climate change and seal predation on the distribution and abundance of herring in the Strait of Georgia

Doug Hay, Bruce McCarter, Kristen Daniel, Tom Therriault, Department of Fisheries and Oceans Canada*

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Fisheries and Oceans Canada collects detailed records of timing and distribution of herring spawns in BC. Since 1930 many local changes in timing and distribution have occurred including cessation of spawning in some areas. Some argue that local spawning cessation reflects serial depletion of local stocks by roe fisheries. We reviewed data on the locations and timing of fisheries and spawning areas but found no evidence of serial depletion. Spawning sometimes stopped in areas without fisheries and continued in areas with fisheries and started in new areas. Also, herring spawn shifts to the north in warmer years but we suggest that a major factor affecting herring spawn distribution is predation by harbour seals (*Phoca vitulina*) that have increased tenfold in the last 30 years. The coastal waters of BC and Puget Sound now have the highest density of harbour seals in the world. Further, total predation by seals on herring may be relatively small compared to herring biomass but we show that predation rates could be substantially higher for the smaller, peripheral non-migratory herring that usually have later spawning times. A consequence is that in some areas herring could be continuously grazed down. This would explain both the apparent disappearance of some local herring stocks and changes in spawn timing and distribution.